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Efficacy of orange peel as a mosquito repellent

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Abstract

The textile sector is facing new challenges in the modern days and every technician is giving the best to face these challenges, the world that world lead us would be astonishingly hi tech and materialistic. To ensure our security and safety from the future hazards, we need equally developed technology for our protection. Protective textiles are among one such smart application of smart technology in textiles. Protective textiles refer to those textile products which have a functionality of giving protection from something in some or the other sense. Mosquito repellent finished textiles are also a part of protective textiles. Which help in protection from the species that are prone to cause damage in some or the other manner. Mosquito are among the most common and widely distributes insects. It has earned a worldwide reputation as torturers of man and also diseases carries. Mosquito are classified as one of the deadliest pests known to man. The activity of mosquito is affected by climate, light and temperature. Mosquito repellent textile is one of the revolutionary ways to advance the textile field by providing the much needed features of driving away mosquitoes, especially in the tropical areas. It protects the human being from the bite of mosquitoes and there by promising safety from the mosquito borne disease, such as malaria, dengue fever, chicken gunia and filarial. Most plant contains compounds that they use in preventing attack from phytophagous (plant eating) insects. These chemicals fall in to several categories including repellents, feeding deterrents, toxins and growth regulators. Repellents of plant origin do not pose hazards of toxicity to human and domestic animals and are easily biodegradable. Natural products are safe for human when compared to that of synthetic compounds. Plant-based repellents have been used for generations in traditional practice as a personal protection measure against host-seeking mosquitoes. The abundance of plants on the earth surface has led to an increasing interest in the investigation of different extracts obtained from the traditional plants as potential sources of new mosquito repellent agent. The current study is mainly carried out for the development of mosquito repellent cotton fabric using "orange peel" extracts.

Keywords Mosquito repellent finish, cotton fabric, orange peel, textile sector

1. Introduction

Most plant contains compounds that they use in preventing attack from phytophagous (plant eating) insects. These chemicals fall in to several categories including repellents, feeding deterrents, toxins and growth regulators. Repellents of plant origin do not pose hazards of toxicity to human and domestic animals and are easily biodegradable. Natural products are safe for human when compared to that of synthetic compounds. Therefore, it is the hour to launch extensive search to explore eco-friendly biological materials for control of insect pests. The phytochemicals derived from plant resources can act as larvicidal, insect growth regulators, repellents and ovipositional attractants, having deterrent activities observed by different researchers. The plant products have been used traditionally to repel or kill the mosquitoes in many parts of the world. The urgent need for the investigation of phytochemicals as repellents for mosquito control.

So the Cotton is the natural vegetable fiber of great economic importance as a raw material for cloth. It is the oldest and the most important fabric. It has been used for apparel purpose since centuries and known as white gold or the king of fabric. Cotton fiber is the background of the world textile these fibers are mainly known for its strength, high absorbency and good wearing qualities. Other exception features like excellent launderability easy finishability and good pliability in cotton fabric make it easy to produce a variety of organic mosquito repellent fabric.

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2. Methods and Material

2.1 Selection of fabric

Based on the properties like absorbency, bio-degradable, nontoxic, high strength, non-allergic, cool and softness. 100 percent cotton was obtained from C.S.A. University and Agriculture, Kanpur, U.P.



Plate 1: Dried and ground orange pe

2.2 Selection of sources

Natural finishes have many advantages such as non-toxic, biodegradable, cost effective and availability. Orange peel (*Citrus sinensis*) was selected as a mosquito repellent agent.

2.3 Medium of dye extraction

Orange peel was extracted in methanol medium and it was evaluated on the basis of optical density.

2.4 Selection of mordant

This natural finishing agent could not adhere into the fabric directly and require binder. The easily available source like citric acid was selected as a binder.



Plate 2: Methanol extraction of orange peel

2.5 Optimization of orange peel mosquito repellent variable

A series of optimization of concentration of organic mosquito repellents, optimization of concentration of organic mosquito repellent extracts, Optimization of padding time. These variables were optimized based on optical density of the concentration mosquito repellent.

2.6 Method of Mordanting of orange peel mosquito repellent

Mordanting was carried out by using post mordanting. It was selected for mosquito repellency test and wash durability.

2.7 Preparation of final sample

Final samples were prepared from the selected mosquito repellent sources with orange peel mosquito repellent. Condition and optimized concentration of mordants and methods of mordanting. These samples were tested for the bending length, tensile strength, thickness, and crease recovery angle. Each sample was then evaluated for mosquito repellent finish test and wash durability test.

3. Results and Discussion

Mosquito repellent medium of methanol extract was selected as the best for orange peel.

Optimizations of orange peel concentration in methanol, mosquito repellent extract concentration time and padding time. In order to record optical density of organic mosquito repellent sources λ_{max} of orange peel was fixed 765 nm. optical density of five different concentrations i.e.; 20,25, 30, 35 and 40 per cent of orange peel powder was recorded at 765nm λ_{max} (Table.1).Optical density of 30 g orange peel powder in 100 ml of methanol gave highest value (2.19), therefore selected as optimum.

Table 1: Optical density of different concentrations of orange peel mosquito repellent

S. no	Sample code	Concentration (%)	$(\lambda)_{max}$ (nm)	Optical density
1.	O.P.1	20	765	1.13
2.	O.P.2	25		1.64
3.	O.P.3*	30*		2.19*
4.	O.P.4	35		2.18
5.	O.P.5	40		2.18

O.P. - orange peel

3.1 Standardization of concentration of orange peel mosquito repellent extracts

Mosquito repellency of different concentration of extract of orange peel is presented in table.2. Orange peel extract was taken in 40, 50 and 60 per cent. Data depicts that on increasing concentration from 40 to 60 per cent mosquito repellency also increases from 10 per cent to 80 per cent, therefore 60 per cent extract concentration of orange peel organic mosquito repellent was standardized for finishing of cotton fabric.

Table2: Mosquito repellency of finished sample with Orange peel extract

Organic Mosquito Repellent	Optimized conc.	Extract conc. (%)	Padding time (minutes)	Mosquito repellency (%)
O.P.	30%	40	60	40
			90	50
			120	60
		50	60	80
			90	85
			120	90
		60*	60	92
			90	95
			120*	100*

O.P. - orange peel

3.2 Standardization of padding time

Results are shown in table. 2. Data indicates that mosquito repellency of orange peel samples increases with increasing time form 60 minutes to 120 minutes. Samples padded for 120 minutes with 60 per cent extract concentration showed 80 per cent mosquito repellency, therefore this time was selected for finishing of orange peel samples.

3.3 Standardization of variables for after treatment of finished samples

Cotton samples were finished with standardized concentration of organic mosquito repellent extract of orange peel for optimized time. These samples were given after treatment with different concentration of citric acid for different time.

3.4 Standardization of concentration of citric acid and time

Wash durability and mosquito repellency of finished samples mordanted with 5, 10 and 15 per cent concentration of citric

acid for 30, 60, 90 minutes were checked side by side and result are shown in table 3.

Samples finished with orange peel mosquito repellent extract were also given after treatment with 5, 10 and 15 per cent concentration of citric acid for 30, 60 and 90 minutes and finding are presented in table 3. Results clearly reveals that mosquito repellency and wash durability after each laundering improves with increase of concentration from 5 to 10 per cent but decreased on furthers increasing of concentration from 10 to 15 per cent; therefore 10 per cent concentration of citric acid was finalized for after treatment of orange peel samples. Wash durability of samples improves with increase of concentration of citric acid from 5 to 10 per cent after each laundering whereas it started decreasing with further increase in concentration of mordant from 10 to 15 per cent therefore 10 per cent concentration of citric acid was finalized for mordanting of samples finished with orange peel extract.

Table 3: Mosquito repellency of mordanted finished samples with orange peel after laundering

S. No.	S.c.	Ext. Conc.	Padding time	Mordt. Conc.	Time of after treatment	Mosquito Repellency (%)									
						1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
2	O.P.	60%	120 MINS	5%	30MIN	40	30	20	10	2	-	-	-	-	-
					60 MIN	45	40	30	20	5	-	-	-	-	-
					90 MIN	50	45	35	25	10	-	-	-	-	-
				10%*	30MIN	80	70	50	30	15	-	-	-	-	-
					60 MIN*	80	70	60	40	30	15	-	-	-	-
					90 MIN	75	50	45	25	10	5	-	-	-	-
				15%	30MIN	60	40	32	25	10	-	-	-	-	-
					60 MIN	60	40	30	20	5	-	-	-	-	-
					90 MIN	50	40	20	10	5	-	-	-	-	-

3.5 Standardization of time for after treatment

Time for after treatment of finishing of samples with different orange peel mosquito repellent i.e. orange peel. Data (Table 3) reveals that after treatment for 90 minutes with 10 per cent concentration of citric acid produces best results hence this treatment optimized for mordanting of orange peel samples. Mosquito repellency samples was checked after each laundering and observed that mosquito repellency decreases on increasing the time of after treatment from 30 to 90 minutes with 5 per cent and 10 per cent concentration of citric acid while it showed decreasing in trend with 15 per cent concentration. Mosquito repellency and washing durability upto 5th laundering increases for after treatment from 30 to 90 minutes for 5 per cent concentration whereas mosquito repellency decreases with 15 per cent concentration on increasing time. Mosquito repellency of 15 per cent was observed upto 6th laundering in samples treated for 60 minutes time with 10 per cent citric acid, therefore this time was optimized for mordanting of orange peel samples.

3.6 Standardized Finishing Recipes

Recipes of organic mosquito repellent Orange peel for finishing of cotton fabric with standardized condition were given in (table 4) from the data it is clear that methanol extraction of 30 per cent of Orange peel powder was done and sample was padded with 60 per cent Orange peel extract concentration for 90 minutes. This sample was then dried at 90 °C for 5 minutes in hot air oven. After that finished sample was given after treatment with 10 per cent citric acid for 90 minutes and cured for 2 minutes at 120 °C temperature. Findings clearly depicts that drying temperature and time were kept same for Orange peel organic mosquito repellent sources concentration of citric acid for after treatment of sample was also same and all sample were cured at same time and temperature. It was observed that wash durability and mosquito repellency was decreased in sample on increasing the concentration of citric acid.

Table 4: standardized finishing condition for orange peel mosquito repellent finish for cotton fabric

S. No.	Organic mosquito repellents	Conc. of o.m.r.	Extract Conc.	Padding time	Dry temp. & time	Curing conc.	After treatment	Curing temp. & time
1.	Untreated Cotton fabric	-	-	90 mins	90.C for 5 mins	-	60 mins	120° for 2 mins
2.	Orange peel	30%	60%	90 mins	90.C for 5 mins	10%	60 mins	120° for 2 mins

3.6 Effect of mosquito repellent finish on the physical properties of cotton fabric

3.6.1 Physical Properties Test

The physical properties viz, bending length, crease recovery angle, drape co-efficient, tensile strength, Thickness of the

control (untreated fabric) and mosquito repellent sample (bleached with selected concentration) were carried out. The results are registered in table 5.

“Paramount thickness gauge” was used to measure the thickness values of cotton samples. It was found that the

mosquito repellent finished samples thickness slightly increases in 22mm. as comparison to untreated fabric. Bending length was measured using Shirley's cloth stiffness tester in both warp and weft directions. Cotton fabric finished with Orange peel in bending length warp direction 2.5 cm. and weft direction 2.94. It was seen that Orange peel treated fabric became softer and pliable stiffness in cotton fabric when compared with unfinished cotton fabric. The bending length untreated cotton fabric sample was 3.62 cm in warp and 3.46 wefts.

Crease recovery angle was measured for both warp and weft directions treated cotton samples compare with untreated cotton sample using "Eureka crease recovery tester." Crease recovery angle of untreated sample was (warp) 35.8° and (weft) 53.6°. Orange peel samples showed sharp increase in crease recovery angle from 47.8° to 68.8° in warp direction and little difference. It was also observed during experiment that crease recovery improves with mosquito repellent

finishing treatment especially in warp direction.

Drape coefficient of finished and unfinished cotton fabric was measured and data are given in table 5. As per findings it is clear that drape coefficient of unfinished cotton samples was 0.84 and 0.86 in warp and weft direction respectively where as drape coefficient decreased in finished samples. Orange peel showed large decreases in drape coefficient it was observed that orange peel organic mosquito repellent improves the drapability of fabric. Drape of fabric improves in treated fabric than untreated fabric.

From the table 5 it is clear data strong of untreated finished cotton samples was 29.4 kg in warp and 36.4 kg in weft. Strength of cotton fabric finished with organic mosquito repellent orange peel slightly decreased in warp and weft direction which ranges from 29.4 to 25.4 and 36.6 to 34.5 kg. On analysis strength values statistically, it was found that all four organic mosquito repellent had insignificant effect on strength of finished fabric.

Table 5: Effect of finishing treatment on fabric properties

Sample code	Fabric stiffness test (cm)		Crease recovery (°)		Drape coefficient		Tensile strength (kg)		Thickness (mm)	
	Warp	Weft	Warp	Weft	Warp	Weft	Warp	Weft	Warp	Weft
Untreated	3.62	3.46	35.8	53.6	0.84	0.86	24	31.8	0.19	0.19
Orange Peel	3.22	3.18	68.8	53	0.24	0.20	29.4	34.6	0.18	0.17

4. Conclusion

On the basis of result obtained, it can be concluded that the material to concentration and extract concentration of organic mosquito repellent agent a significant difference in Finished and mordant samples were checked for physical properties viz.; fabric stiffness, crease recovery, drape coefficient, thickness and tensile strength. These parameters were compared with untreated cotton samples. Data depicts that stiffness of cotton fabric decreases when treated with orange peel fabric becomes softer and more pliable stiffness. Crease recovery of treated samples showed increases in warp direction while little difference was observed in weft direction. Statistical analysis revealed significant difference at 1 per cent level of significance. It is observed that drapability of orange peel organic mosquito repellent improves in drapability. Drape of fabric improved in treated fabric than untreated fabric. The difference found was significant ($p < 0.01$). Thickness of treated samples showed significant difference in warp direction while highly significant difference in weft direction. Tensile strength of finished cotton fabric decreases in comparison to unfinished sample but statistically the difference was insignificant.

5. References

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